FORESTRY RESEARCH

WHAT'S NEW IN THE WEST

U.S. Department of Agriculture Forest Service

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What's Inside

a note to you

Forestry Research: What's New in the West, is a report on the work of the USDA Forest Service's four Forest and Range Experiment Stations in the West. These research centers, and the States included in their areas of study are: Rocky Mountain (North Dakota, South Dakota, Nebraska, Kansas, Colorado, Arizona, New Mexico, and part of Wyoming, Oklahoma, and Texas); Intermountain (Montana, Idaho, Utah, Nevada, and part of Wyoming); Pacific Northwest (Alaska, Oregon, and Washington); and Pacific Southwest (California, Hawaii, and the Pacific Basin).

on the cover

Evelyn Bull's study of nesting pairs of pileated woodpeckers and their young requires banding birds for later identification. Here Howard Cooper, a smoke-jumper, climbs to a nest to retrieve young birds. See "Saving Snags for Woodpeckers" on facing page.

our addresses

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Saving snags for woodpeckers

At the age of 24 days, this male pileated woodpecker is almost ready to leave the nest and learn from his parents how to forage for food in downed logs and snags.

A forest manager who wants to harvest timber and still provide habitat for a variety of birds and small mammals might try making the neighborhood attractive to pileated woodpeckers. When the pileateds move in, they are followed by a variety of cavity-dwelling birds and small mammals whose principal food is insects which damage forest trees. Simply by pleasing the pileateds, the forest manager can provide habitat for wildlife that will exert constant pressure on insect populations.

Advice on how to attract these large, red-headed woodpeckers comes from Evelyn Bull, a wildlife biologist with the Pacific Northwest Forest and Range Experiment Station's Wildlife Habitat Laboratory in La Grande, Oregon. For the past five years she has been studying the habitat needs of woodpeckers at the nearby Starkey Experimental Forest. Although her findings are specific to the Blue Mountain region of northeast Oregon and southeast Washington, they also apply generally to other habitat types in the West.

Young birds are examined, weighed, and banded by Evelyn and her assistant Siri Jackman.

Evelyn considers the pileated the most important of the woodpecker species. "Besides eating insects, the pileated is a primary excavator," she says. "Each year it excavates nests and roosts that later become homes for a variety of insectivorous birds and other wildlife." In the Blue Mountains, there are 22 species of birds and 24 species of mammals which are not capable of excavating cavities but use them for nesting, roosting, shelter, or hibernation.

Since the pileated is a large bird, its most critical need is for sound snags big enough to accommodate a cavity approximately 9 inches in diameter and 22 inches deep. "If we provide snags large enough for the pileated to nest in, we will probably also meet the needs of other woodpeckers," Evelyn says.

A selective bird

Because of the importance of the pileated, Evelyn concentrated her research on that species the first three field seasons, adding seven more woodpecker species in the past two seasons. She began her studies by measuring

the characteristics of snags, logs, and stumps along 48 random transects on the study area to determine whether the pileated are selective in their choices of nests, roosts, and feeding areas. They are.

Evelyn reached this conclusion after making a detailed study of a total of 15 pair of pileateds in four field seasons. She followed their activities from April, when they began excavating their nests, until late fall. She made careful measurements of the characteristics of the snags, logs, stumps, and surroundings they selected. By comparing these measurements with those made along the random transects, she learned more about the habitat requirements of the species.

On the Starkey Experimental Forest the pileateds prefer ponderosa pine and western larch for nests, although they are known to use other tree species, including cottonwood if it is available. The birds Evelyn has studied have chosen snags 23 to 39 inches in diameter at breast height and 39 to 121 feet tall. The snags usually have no bark, often have broken tops, and are located in clusters in dense timber stands. The nests are built from 23 to 62 feet above the ground but always well below the top of the stand canopy. A pair of pileateds excavates a new nest each year, often in the same neighborhood but seldom in the same snag. In addition to the nest, each bird may excavate an individual roost cavity which it uses at night and in bad weather.

The pileateds forage for insects in downed logs and standing snags and stumps. On the Starkey Experimental Forest they feed in ponderosa pine, larch, lodgepole pine, or grand fir. Size apparently is not important, although the birds seldom forage in dead wood less than 7 inches in diameter. Feeding sites are usually in dense mixed species, with a high density of logs and snags and tall ground cover. Carpenter ants are preyed on heavily during the summer months, while bark beetle larvae make up a large part of their diet during the winter.

320 acres

From her research so far, Evelyn has concluded that maintaining habitat for pileated woodpeckers requires a minimum of 320 acres for each nesting pair. Those parts of a forest that are being maintained for pileated habitat should have 90 snags of greater than 20 inches in diameter per square mile, plus potential replacement snags.

One of Evelyn's assistants during the summer of 1977 was her 17-year-old sister Amy, a Forest Service volunteer.

Young birds are hauled back to the nest in a cloth sack.

The characteristics of pileated habitat are found primarily in mature forests, which are also home to many other species of wildlife. The other woodpeckers in Evelyn's study — the common flicker, the white-headed woodpecker, the yellow-bellied sapsucker, Williamson's sapsucker, the hairy woodpecker, the black-backed three-toed woodpecker, and the northern three-toed woodpecker — may also excavate their nests there. While these birds prefer snags of differing diameter, height, and hardness, they can use the same snags the pileated use for nesting and feeding.

Evelyn feels there are several ways mature forests can be managed to maintain habitat for pileated woodpeckers and still harvest timber. "But," she says, "there must be a realization that large snags, logs, diseased trees, and large trees are definitely needed, not just to benefit pileated woodpeckers but all woodpeckers and other cavity nesters."

Predicting the long-term consequences of timber management activities on all wildlife is part of a forest manager's job. He is also required to comply with laws which direct attention to the welfare of wildlife. These include the Multiple Use Sustained Yield Act of 1960 and the Endangered Species Act of 1966. The National Environmental Policy Act of 1969 requires that the impacts of management on all wildlife be accounted for and predicted. The Resources Planning Act of 1974 provides for habitat management for the use and enjoyment of wildlife and for maintaining an adequate diversity and number of fauna.

While providing habitat for a diversity of wildlife is not likely to be the dominant management objective in all forest areas, information about the needs of each species will make it easier for forest managers to evaluate management plans in terms of their impact on resident wildlife. Evelyn says, "It is important to support at least a reservoir of species that can disperse to repopulate other areas as habitat becomes available in the future. Nest sites may be the critical factor which limits reproduction of pileated woodpeckers, and indirectly, the species that use their vacated cavities."

Evelyn's studies are reported in the June 1977 issue of the *Journal of Forestry* in an article co-authored by E. Charles Meslow, titled "Habitat requirements of the pileated woodpecker in northeastern Oregon." Reprints are available from the Pacific Northwest Station.

— By Dorothy Bergstrom, Pacific Northwest Station

Genes and greener forests

The forest lands of the Northern Rocky Mountains, some of the most productive in the Inland West, are mixed conifer forests, often with several species growing simultaneously on one site. The ecological variation in these forests, totaling 55 million acres, is tremendous. Aspect, elevation, climate, and habitat type change rapidly from one site to another.

This variation poses a challenge to Intermountain Station researchers concerned with genetics and pest resistance. Their primary objective is to assess the genetic variation in these forests from geographical and ecological perspectives.

Ray Hoff, Project Leader of the research work unit located at the Forestry Sciences Laboratory, Moscow, Idaho, says, "Once this variation is identified, large groups of trees with similar adaptive requirements could be identified. Then managers could avoid planting of seedlings not adapted to a site. Tree breeders would also have a unit within which intensive selection could be made for desired traits."

Planting container-grown Douglas-fir seedlings at the Priest River Experimental Forest nursery.

In a recent study, Geneticist Jerry Rehfeldt developed seed zones for inland Douglas-fir. As a result, forest managers of the inland region have begun a tree improvement program with Douglas-fir based on eight zones and 300 superior trees within each zone. These will form a base for an intensive Douglas-fir selection program for future forests.

In another study, Rehfeldt found that a 30-percent gain in growth can occur when the fast-growing coastal Douglas-fir variety is crossed with the slower growing inland variety. However, the hybrid is not quite hardy enough to withstand the rigors of the inland environment. He recommends that foresters either backcross the hybrid with the inland variety for a possible fast-growing, well-adapted individual, or that crosses be made between the inland variety and natural hybrids from the coastal and inland varieties in southern British Columbia.

Rehfeldt and coworker Ray Steinhoff have determined that, in contrast to Douglas-fir, western white pine does not vary genetically with geographical or habitat factors. This was a surprise to the researchers — they expected groupings. Obviously, western white pine has a different adaptive strategy. Breeders of white pine are delighted — they can concentrate on breeding for blister rust resistance and other desirable traits without concern for environmental maladaptation.

Insects and diseases such as white pine blister rust are widespread throughout the region's forests. Many of them are not critically damaging except when certain environmental conditions exist or land management practices upset established genetic systems.

Pollinating rust-resistant western white pine.

Genetic resistance

One of the most attractive methods for controlling pests in forest trees is genetic resistance. Although little used in forestry, the approach has been used successfully by crop breeders to control many pests of agricultural crops.

One of the real success stories in forest genetics is the development of blister rust resistance in western white pine. Since the turn of the century, when the disease was brought to this country from Europe, white pine blister rust has destroyed millions of western white pines throughout North America. The rust infests nearly all western white pine in Idaho, eastern Washington, and western Montana, and has killed up to 95 percent of the white pine in locations most favorable to the rust.

As early as 1927, some foresters noticed that certain trees appeared to be resistant to white pine blister rust. In 1950, a study conducted by former Intermountain Station researcher Richard T. Bingham showed that resistance to the disease is inherited. He also found that western white pine contains many different resistance mechanisms that are controlled by many genes. When tested in the nursery, the level of resistance after two cycles of selection was about 60 percent. Field resistance was even higher — 80 percent of second generation seedlings were disease-free seven years after planting in a high hazard site.

Measuring grand fir progeny at the Coeur d'Alene nursery.

The researchers have identified several races of white pine blister rust. This should not surprise anyone, Hoff says, but it emphasizes the point that the new varieties of western white pine must contain high gene diversity when it comes to blister rust resistance.

A new resistant variety of western white pine is in production. Nearly 400 pounds of seed have been collected from 3,000 highly blister rust-resistant western white pines at the Sandpoint seed orchard and the Moscow arboretum.

Some of this seed formed the first commercial plantation of genetically improved, blister rust-resistant, white pine seedlings in the five-state area of the Northern Region. Located on the Palouse Ranger District of the Clearwater National Forest, Idaho, the 60-acre Dick Bingham Plantation consists of second-generation seedlings of trees developed from grandparents selected for apparent resistance.

Dedicated in 1974, the plantation is a payoff of more than 25 years of genetics research by Bingham and his associates.

Man-guided breeding programs are especially vulnerable to natural processes. New races of fungi arise; new pests are introduced; a once-in-a-century, off-season cold spell or an unusually severe drought can ravage the new varieties. Hoff says it is important that new varieties of forest trees, produced either by tree improvement efforts or other silvicultural manipulations, maintain fitness for the environment. The researchers propose a breeding approach for the development of resistance in western white pine that uses more natural processes in conjunction with intensive breeding programs.

The natural control approach was the basis for a recent study on mass selection for blister rust resistance as a method for natural regeneration of western white pine. Based on the coexistence of host and parasite, the breeding philosophy uses nature's method — taking advantage of gene diversity in natural ecosystems. Hoff says the genetically diverse seed crops would have stable resistance and broad adaptability.

Technician waters containerized tree seedlings growing in a 40-percent-shade house at the Moscow nursery.

Mass selection for blister rust resistance has been going on for years — ever since blister rust killed the first white pine. Natural mortality in some white pine stands has reached 80 to 90 percent, but the remaining trees in the stands have been selected for resistance to the disease. Hoff says the biggest advantage of mass selection is its simplicity — it can be incorporated into existing practices. He adds that some foresters, using their biological knowledge, have already used this approach.

Control of blister rust

Hoff and Intermountain Station researcher Geral McDonald have some tips for land managers looking for ways to control blister rust in present white pine stands. They suggest that it is desirable to leave some white pine in a stand because it may be the "best" tree for the site, and the progeny of the surviving trees will be more resistant to blister rust. They have developed several approaches for identifying the best "leave-trees," based on the age of the stands.

Hoff says, "As we learn more about the genes of the various species we will be able to select the best types for sites, where their productivity will be high, relatively free from the ravages of insects and disease."

If you would like to know more about these studies, write to the Intermountain Station for the following publications:

Hoff, R. J., and G. I. McDonald, 1977. Selecting Western White Pine Leave-trees. USDA For. Ser. Res. Note INT-218-FR13.

Hoff, R. J., G. I. McDonald, and R. T. Bingham, 1976. Mass Selection for Blister Rust Resistance: a Method for Natural Regeneration of Western White Pine. USDA For. Serv. Res. Note INT-202-FR13.

McDonald, G. I., and R. J. Hoff, 1975. Resistance to *Cronartium Ribicola* in *Pinus Monticola*: an analysis of needle-spot types and frequencies. Can. J. Bot. INT-R-425-FR13.

Rehfeldt, G. E., 1974. Genetic Variation of Douglas-fir in the Northern Rocky Mountains. USDA For. Serv. Res. Note INT-184-FR13.

Rehfeldt, G. E., 1977. Growth and Cold Hardiness of Intervarietal Hybrids of Douglas-fir. Theoret. Appl. Genet. 50:3-15, INT-R-514-FR13.

Rehfeldt, G. E., and R. J. Hoff, 1977. Proper Seed Source — a Key to Planting Success. In: Baumgartner, D. M., and R. Boyd. Tree planting in the Inland Northwest. INT-R-517-FR13.

—By Delpha Noble, Intermountain Station

Protecting pines from bark beetle

Researchers in California are experimenting with treatments to protect high-value pines that are threatened by bark beetle attack. In a series of field studies, Research Entomologists Richard H. Smith and C. J. DeMars of the Pacific Southwest Station are trying to determine if hand-spraying insecticides on the lower boles of ponderosa and lodgepole pine will protect these trees from western and mountain pine beetle. These bark beetles are among the most destructive insects that attack Western forests.

The type of tree-by-tree application that Smith and DeMars hope to develop is not intended for commercial forests, because the cost of individually spraying boles of large numbers of trees would outweigh the benefits. Remedial measures, such as sanitation cutting to harvest trees that are highly susceptible to beetle attack, or salvage logging, to remove beetle-killed trees, are more economical. So, the protective spray techniques that Smith and DeMars are testing are intended for use on small numbers of high-value trees that are threatened by a nearby, active population of bark beetles. Such trees may be in campgrounds, vista areas, research plots, special management areas, seed orchards, greenbelts, urban or suburban parks, or in a homeowner's backyard.

A researcher, wearing protective gear, applies insecticide to trees in a study plot.

The scientists' goals are to determine which insecticides will keep these high-value trees alive, how much chemical to use for long-term effectiveness, where to apply it on the tree, what time of the year to spray, and what equipment to use.

The California researchers are coordinating their experiments with similar single-tree protection studies that are underway in other parts of the country. These include studies by Rocky Mountain Station scientists who are testing sprays to protect high-value pines in Colorado, and experiments by Southeastern and Southern Experiment Station researchers to protect pines from the southern pine beetle.

Insecticides that Smith and DeMars are using are: lindane (gamma benzene hexachloride); Sevin (carbaryl); Dursban (chlorpyrifos); and Reldan (chlorpyrifos methyl). In their experiments, they are using water emulsions instead of the more expensive diesel oil formulations that are sometimes toxic to trees with thin bark.

The Pacific Southwest Station studies include a field experiment on the Shasta-Trinity National Forest in northeastern California, and several controlled tests at the Institute of Forest Genetics in Placerville.

The field experiment on the Shasta-Trinity National Forest began last summer, when the researchers sprayed test trees on 24 study plots with either 0.25 percent, 0.50 percent, or 1 percent formulations of lindane, or 0.50 percent, 1 percent, or 2 percent formulations of Reldan. They applied the sprays to the lower 30 to 35 feet of the bole — the zone the beetles most often attack — with a small, pressure-tank sprayer. They used about 1 gallon of spray per 40 feet of bark to wet the bark to the point that excess spray ran off. All of the test trees were free of beetle attack at the start of the experiment.

Monitoring beetle activity

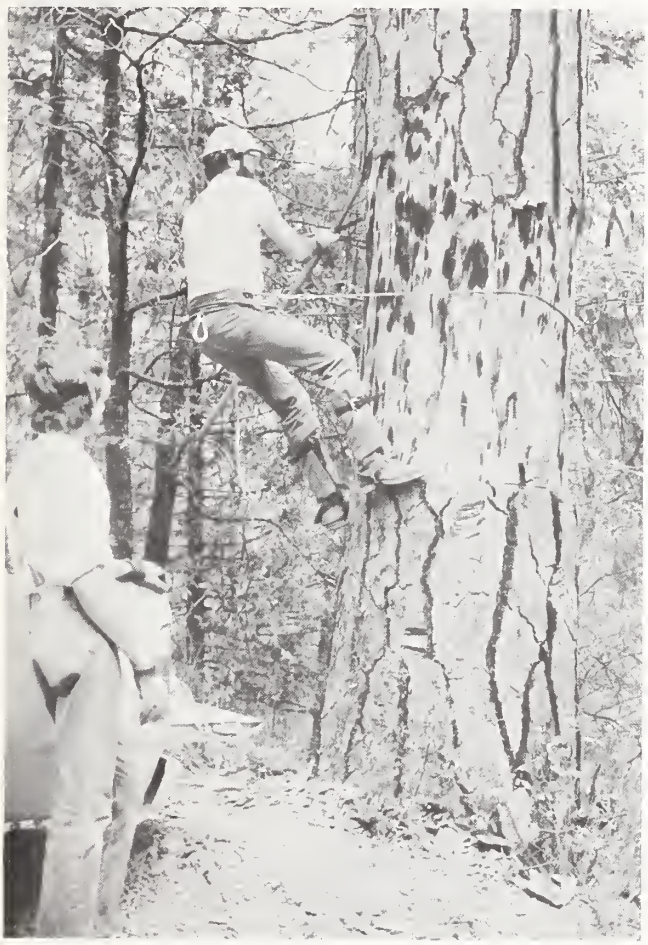
Two months later, they placed synthetic attractants and containers of beetle-infested bark in 10 of the study plots, to ensure that the test trees would be exposed to attack.

Cardboard cartons full of beetle-infested bark were placed in the study plots.

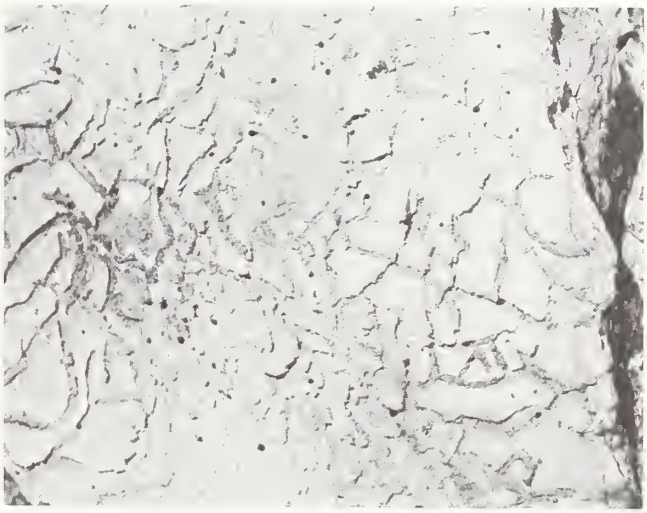
Throughout the early fall, when the beetles were in flight, the scientists monitored beetle activity. They used sticky traps and catchment nets to sample the numbers of beetles that arrived at the test trees, and noted successful attacks — those in which the insects were able to bore into the trees and construct egg galleries beneath the bark.

This coming spring, the scientists will again use attractants and bark from brood trees to expose test trees in 10 more plots to attack, and will monitor these attacks. Because this portion of the experiment will take place about 10 months after the initial spraying, it will indicate how long the chemicals remain toxic to the western pine beetle.

Four of the plots are being used for a special study of the rate at which insecticide residues on the pine bark deteriorate. Researchers Marion Page and Carl Crisp of the Pacific Southwest Station's Insecticide Evaluation Project in Berkeley are conducting a laboratory analysis of the amounts of residue remaining in the bark 1 week, 1 month, 3 months, and 10 months after spraying. Their samples are bark discs, one-half inch in diameter, taken from the tree trunks. They are using discs from both northern exposures and the hotter, drier southern exposures, to see if the orientation of the trees affects the rate at which the insecticides deteriorate. Rates will be compared to the number of beetle attacks, to determine long-term effectiveness of the sprays.



Bark was stripped from trees infested with western pine beetle, and was placed in the study plots.



In successful attacks, bark beetles are able to excavate egg galleries beneath the bark of host trees.

Smith's controlled experiments at the Institute of Forest Genetics, Placerville, are intended to supplement the California and Oregon field tests. The Placerville studies are log bioassays, in which Smith applied candidate chemical sprays to trees that beetles had not attacked, let the treatments age for various lengths of time, and then felled the trees and forced mountain and western pine beetles to attack the logs. For these "forced attacks" the beetles are placed in hardware cloth cages that enclose the logs. Smith is using egg gallery construction as the indicator of beetle success, and is comparing inches of egg gallery constructed in the treated bolts to gallery lengths in untreated bolts.

In one of these experiments, Smith is testing the residual efficacy of 0.5 percent and 1 percent emulsions of lindane on trees that have been exposed to different amounts of sunlight and moisture. For this study, he is using 20 beetles per square foot of bark, and 100 beetles per square foot, in caged attacks 3 and 6 months after spraying. In another of these studies, Smith is testing the strength of 0.5 percent Dursban, lindane, Reldan, and Sevin at 1, 2, 3 and 6 months after spraying, to determine short-term effectiveness of these insecticides at this low dosage. Again, he is using populations of both species of beetles in the caged attacks.

Researchers used sticky traps and catchment nets to estimate the number of beetles that attacked test trees.

Entomologist Galen Trostle of the Forest Service's Pacific Northwest Region, Portland, is assisting Smith in a study of the effectiveness of insecticides in protecting high-value, high-risk lodgepole pine from mountain pine beetle. This test is on the Wallowa-Whitman National Forest, near Baker, Oregon. There, trees in study plots were hand-sprayed last spring with 0.5 or 1 percent lindane, 1 or 2 percent Dursban, or 1 or 2 percent Sevin. Plots were monitored through the beetle's summer flight period, and will be checked again this coming spring, when faded foliage or other indicators of beetle-caused tree kill should be evident.

Pine beetle predators

In addition, the Pacific Southwest Station has arranged for a University of California, Berkeley, study of the effects of lindane and Reldan on survival, reproduction, and feeding habits of two insects that are important predators of the western pine beetle. These are the black-bellied clerid, *Enoclerus lecontei,* and the blue-green ostomid, *Temnochila chlorida.* By feeding on the western pine beetle, the clerid and ostomid act as natural controls of bark beetle populations.

"From our previous study, we know that lindane, Dursban, and Sevin will protect living pines from attack by bark beetles. In our current studies, we hope to find the lowest possible concentration of chemical that will give adequate protection, with a minimum of health and environmental hazards," Smith says. "We've added Reldan to our experiments because it is a newer insecticide that seems promising and possibly less hazardous. We are regarding it, along with Dursban and Sevin, as possible alternatives to lindane. This is because lindane may be restricted in the future."

If one or more of the candidate chemicals are registered for this specific purpose, the data gathered in the current experiments will provide information that can be used to develop practical guidelines for protecting high-value trees.

The study that provided background for the current work is described in a reprint available from the Pacific Southwest Station — "Protective Spray Tests on Three Species of Bark Beetles in the Western United States," by R. H. Smith, G. C. Trostle, and W. F. McCambridge, Journal of Economic Entomology, 70(1): 119-125.

Further information about the experiments is available from R. H. Smith at the Pacific Southwest Station, P.O. Box 245, Berkeley, California 94701; telephone (415) 486-3573 (FTS: 449-3573).

— By Marcia Wood,
Pacific Southwest Station

Fighting tree diseases in the Great Plains

Plant pathologist Jerry Riffle examines fruiting body of heartrot fungus on green ash in a windbreak.

The need for trees in the Great Plains has been recognized since pioneering days. Trees grouped together as windbreaks or shelterbelts protect the fertile topsoil from wind erosion. They also contribute to many aspects of moisture conservation — collecting snow and rainfall, retarding run-off, reducing evaporation, and channeling surface water to underground waterways. Shelterbelts also help to shield homes, livestock, wildlife, and recreation areas from the harsh prevailing winds of the Plains.

Additional social benefits derived from windbreaks and shelterbelts are: the reinforcement of people's morale that comes with shade from sun glare; the added variety and beauty of the countryside; pride in ownership; and a real increase in value of the home and farmstead.

Tree diseases, however, are taking an increasing toll on shelterbelts, natural forested areas, and residential and ornamental plantings. Unless the disease problems are controlled, the ultimate failure of shelterbelt plantings in some sections of the Great Plains is likely.

The Rocky Mountain Station's Forestry Sciences Laboratory on the University of Nebraska campus, Lincoln, is working to solve disease problems facing Plains forestry.

Disease types

Glenn W. Peterson, leader of the tree disease research at Lincoln says, "one of the most damaging diseases, especially to well-established trees, is *Cercospora sequoiae*" — a blight of eastern redcedar and Rocky Mountain juniper. The disease first attacks the foliage at the base of branches in the lower crown. In an advanced state, trees will have only a tuft of green foliage remaining at the top. Finally, all foliage is killed. Some trees are killed within three growing seasons.

Researchers at Lincoln are investigating Cercospora blight at the University of Nebraska's Horning State Farm, a tree research facility in eastern Nebraska. They have found that, although several fungicides are effective against Cercospora, the time of application is very critical. Fungus spores are dispersed primarily by rain splash. Spores from Cercospora are not abundant until late May or early June and remain active into October. A highly persistent fungicide, such as Bordeaux mixture (a solution of copper sulfate, lime, and water), applied in early June should protect trees for the entire growing season. Because of weathering, however, an additional application later in the growing season might be required.

Phomopsis juniperovora causes a blight that has been a problem for over 70 years in nursery seedling and transplant beds containing eastern redcedar and Rocky Mountain juniper. Young needles are susceptible to infection throughout the growing season. Infected terminals and branches become light in color, then red-brown, and finally ashen gray. Stems of 1- and 2-year-old seedlings are frequently girdled at the base of infected branches. Older stock is less likely to be killed because stems over one-third inch in diameter are usually not girdled. Pruning, in an attempt to control the disease, can actually increase damage, since it forces development of juvenile foliage which is highly susceptible to the fungus.

Researchers have found that the critical period for controlling Phomopsis is during the growing season, when seedlings have new, susceptible foliage. Benomyl, the only fungicide now registered for use in controlling this disease, should be applied frequently during this time. Sowing juniper seed adjacent to beds containing juniper stock should be avoided to eliminate the possibility of infection. Since spore germination does best in high humidity and places where moisture accumulates on foliage, poorly drained areas should be avoided. Losses are often greater where water tends to stand on the soil surface.

Another fungus is attacking Austrian, ponderosa, and Scots pines over 30 years old. *Diplodia pinea* has been so extensive in eastern Nebraska and eastern Kansas that the esthetic value of trees in many residential and park plantings has been destroyed.

The occurrence of resin droplets on shoots is the first indication of infection, usually appearing in May. Infected new shoots turn yellow or tan, and then die.

Diplodia blight can be controlled by two closely-spaced applications of Bordeaux mixture. Arborists who have used spray schedules developed by researchers at Lincoln have obtained excellent control of this disease.

Bordeaux mixture is also effective against *Dothistroma pini*, another disease of pines in the Great Plains. Dothistroma was first recognized in the 1940's and is now found in 23 states. It occurs most frequently on Austrian and ponderosa pines. A recent survey of 60 Christmas tree plantings in Nebraska revealed that half contained dothistroma-infected trees.

Symptoms occur in the fall when yellow and tan spots, and bands that appear water-soaked, develop on needles. The ends of needles eventually die, while the base remains green. Infected needles drop prematurely. Although infection may occur as early as May, symptoms usually do not develop until September or later.

Copper fungicides effectively prevent infection by this fungus. Spores are dispersed from May through October. Older needles are susceptible in late May, newer needles in mid-July. Therefore, two applications will protect trees — the first in mid-May for the older needles, the second in early July for new shoots.

Procedures for control of these diseases farther west may differ from those that are effective in the Midwest because of differences in the life cycle of the fungus, hosts, growth, and weather.

Glenn Peterson and technician Mike Kuhl analyze needles for detection of diseases.

Lincoln scientists are also studying *Botryodiplodia hypodermia*, a fungus which causes cankers on Siberian elm, a major factor in the decline of this species in the Great Plains. Jerry W. Riffle, plant pathologist with the disease project, says that cytospora canker is another disease receiving attention. It occurs on cottonwood and willows in shelterbelts, recreational and reservoir plantings, and in nurseries. The incidence of heartrot fungi on many tree species is also being studied. Over six important heartrot fungi have been identified on green ash, black locust, black walnut, boxelder, honey locust, and American plum.

Other Forest Service scientists at Lincoln are helping in the fight against tree diseases in the Great Plains. They are working to develop "superior" trees by crossbreeding established trees which appear to be resistant to disease and other environmental factors such as temperature stress, drought, and insect attack. Their objective is to develop new genetic strains that will provide healthy, long-lived shelterbelts and other plantings.

The disease research at Lincoln, coordinated with the tree improvement programs, is zeroing in on the most pressing tree disease problems in the Great Plains. Results so far are very promising, suggesting a bright future for Plains woodlands and plantations through proper care.

The following publications on diseases mentioned in this article are available from the Rocky Mountain Station:

Peterson, Glenn W. 1977. Control of Juniper Blight Caused by Cercospora Sequoiae Juniperi. A reprint from American Nurseryman, Vol. 145, No. 12: 13, 50-51.

Peterson, Glenn W. 1977. Infection, Epidemiology, and Control of Diplodia Blight of Austrian, Ponderosa, and Scots Pine. A reprint from Phytopathology, Vol. 67, No. 4: 511-514.

Peterson, Glenn W. 1977. Epidemiology and Control of a Blight of Juniperus Virginiana Caused by Cercospora Sequoiae var. Juniperi. A reprint from Phytopathology, Vol. 67, No. 2: 234-238.

Peterson, Glenn W. 1973. Infection of Juniperus Virginiana and J. Scopulorum by Phomopsis Juniperovora. A reprint from Phytopathology, Vol. 63, No. 2: 246-251.

Peterson, Glenn W. and C. S. Hodges, Jr. 1975. Phomopsis Blight of Junipers. Forest Pest Leaflet 154: 5 p.

Peterson, Glenn W. 1973. Infection of Austrian and Ponderosa Pines by Dothistroma Pini in Eastern Nebraska. A reprint from Phytopathology, Vol. 63, No. 8: 1060-1963.

Riffle, Jerry W., David S. Wysong and Michael G. Boosalis. 1977. White Mottled Heart Rot of Green Ash. Nebraska Guide G77-345, B-3, University of Nebraska, Lincoln: 3 p.

Readers desiring additional information on tree disease research in the Plains may contact Glenn Peterson, Rocky Mountain Forest and Range Experiment Station, Forestry Sciences Laboratory, East Campus, University of Nebraska, Lincoln, Nebraska 68503, (402) 467-3556, FTS operator — 867-5211.

—By Rick Fletcher,
Rocky Mountain Station

Publications

How much does shade count

What are the odds that a shade-tolerant timber species can be perpetuated under uneven-aged management? "It all depends on the competition," says Plant Ecologist Jerry Franklin of the Pacific Northwest Station. "If the intolerant species has aggressive, shade-tolerant competitors, a gradual shift in species will probably occur."

Franklin reviewed the consequences of selection cutting on species composition at a Forest Service Workshop on Uneven-Aged Silviculture and Management in the Western United States in February 1977. He emphasized that species composition is the result of competition among plants in a particular environment or habitat type. He discussed several examples, including the following:

Where the forest type is composed of shade-tolerant species, uneven-aged management is not likely to result in a species shift.

Where an intolerant species has no tolerant competitors, no shift is likely.

On hot, dry forest sites, where it may be difficult to get anything to grow, uneven-aged management may be the safest and most dependable system.

On moist, highly productive sites, where understory plants are competitive, uneven-aged management could occasionally lead to a shift from trees to shrubs and herbs!

Reprints of Franklin's paper, "Effects of Uneven-aged Management on Species Composition," from the proceedings of the workshop are available from the Pacific Northwest Station.

Photos reveal trout habitat condition

Large-scale color aerial photographs of forest streams can be used to analyze trout habitat — with 92 percent accuracy — according to the results of a California study by researchers Wallace J. Greentree and Robert C. Aldrich. They report on their experiments in "Evaluating Stream Trout Habitat on Large-Scale, Aerial Color Photographs," a new Research Paper (PSW-123-FR13) from the Pacific Southwest Station.

For their study, they took color and color infrared photos of a northeastern California stream at three different scales — 1:600, 1:1584, and 1:6000. With these, they were able to correctly identify 92 percent of the physical and biological features that they considered important.

Some of these features were readily apparent when they viewed triplets of the photos through a stereoscope. For example, they found that riffles, pools, and runs that are important to trout and to the aquatic insects trout eat were visible in the 1:1584 color photos. They developed a handy scale to determine whether streambeds were primarily composed of silt, sand, fine gravel, or coarse gravel. And, they used solar azimuth equations and shadow-length measurements to calculate the amount of shade that streamside trees

and bushes will provide throughout the day.

For an overall analysis of a stream and the area surrounding it, they recommend using 1:1584 color photos. For fishery biologists who are concerned primarily with underwater features, 1:600 color infrared photos will probably be the most useful. Other recommendations on the use and interpretation of aerial photos are presented in the report, available from the Pacific Southwest Station.

To thin or not to thin

Commercial thinning of young Douglas-fir stands will pay if thinning is begun early enough on the more highly productive sites. However, on lower sites or in older stands, financial guidelines suggest that stands should be harvested and a new crop begun. These are two conclusions from a recent study by economist Robert M. Randall of the Pacific Northwest Station. Randall provides information for owners and managers of young, merchantable Douglas-fir stands that will help determine whether to thin the stands, allow them to grow further without thinning, or harvest immediately.

Tables show the financial returns and volume yields that can be expected from commercial thinning under certain stand conditions. Detailed assumptions concerning the condition of stands, the way thinning is done, and financial assumptions are provided.

Copies of "Financial Consequences of Commercial Thinning Regimes in Young-growth Douglas-fir," USDA Forest Service Research Note PNW-293, by Robert M. Randall, are available from the Pacific Northwest Station.

On pinyon-juniper woodlands

A workshop, titled "Ecology, Uses, and Management of Pinyon-Juniper Woodlands," was held this past March in Albuquerque, New Mexico, to discuss the ecology and management possibilities of Southwest pinyon-juniper woodlands.

The workshop was sponsored by the Society of American Foresters, Region 3 of the U.S. Forest Service, the New Mexico Department of State Forestry, and the Rocky Mountain Station.

The 12 papers presented ranged from general to very specific topics — The Southwestern Pinyon-Juniper Ecosystem; Pinyon and Juniper Inventory Procedures; Research in the Pinyon-Juniper Woodland; Insects and Diseases of Pinyon-Juniper; Pinyon-Juniper Wildlife Habitats; A Comparison Between Grazed and Ungrazed Juniper Woodland; Product Potential of Pinyon-Juniper Woodlands; What is Known and Not Known About Pinyon-Juniper Utilization; Management of Pinyon for Ornamentals, Christmas Trees, and Nut Production; Forest Practices Needed for the Pinyon-Juniper Type; Managing Pinyon-Juniper for Multiple Benefits; and Systems Approach to Pinyon-Juniper Management.

Readers requesting a copy of the report listing these papers should write the Rocky Mountain Station and ask for General Technical Report RM-39-FR13.

Estimating timber yield

In 1972, mensurationists at the Pacific Northwest Station prepared estimates of yields from Douglas-fir stands managed by thinning and fertilization.

Now, in response to requests for more detail, the researchers have developed a method of simulating stand growth and a computer program to tabulate the results of simulation. A recent report tells how to use the new Douglas-fir Interim Tables (DFIT).

The interim tables include equations that describe the development of natural stands, the amount and timing of mortality in natural stands, and the total cubic-foot increment of thinned stands and plantations. Also included are thinning guides, a method for describing stand components, and assumptions about the effects of management practices on stand development, based on results of Douglas-fir thinning studies.

The paper describes the operation of the simulator in enough detail that the user can make adjustments to fit his needs.

Copies of "Douglas-fir Managed Yield Simulator — DFIT User's Guide," General Technical Report PNW-57, by David Bruce, Donald J. DeMars, and Donald L. Reukema, are available from the Pacific Northwest Station. Arrangements to obtain program decks can be made by calling Bruce or DeMars in Portland (503/234-3361, Ext. 4926, FTS 429-4926) or Reukema in Olympia (206/753-9470, FTS 434-9470). Forest Service users have access to DFIT on the UNIVAC at Fort Collins, Colorado.

Rationing wilderness use

Is there a system of rationing wilderness use that is most acceptable to both the visitor and the wilderness manager?

This question and related concerns are discussed in an Intermountain Station report based on wilderness management research, "Rationing Wilderness Use: Methods, Problems, and Guidelines," INT-RP-192-FR13. Authors are George Stankey of the Station's Forestry Sciences Laboratory, Missoula; and John Baden, Associate Professor of Forestry and Political Science, Utah State University, Logan.

Stankey and Baden evaluate five basic rationing systems — advance reservation, lottery, queuing, price, and merit — that might be used to limit visitor use in wilderness areas. According to the authors, each system has advantages and disadvantages, but ecological and social impacts on wilderness can be controlled by adapting one or more of the systems.

Stankey and Baden summarize the probable impacts of each system with criteria that include administrative experience, acceptability to visitors, and how each system affects visitor behavior. The researchers advise managers to ration only when other measures to control unacceptable impacts fail, and always to develop policies that involve the least regimentation when control is necessary.

Copies of the report are available from the Intermountain Station.

Dead timber resource for paper industry

Much of the dead timber in the Rocky Mountain region is suitable for chipping, and could provide a resource for the pulp and paper industry.

This observation is included in a report published by the Intermountain Station based on research to improve utilization of the vast quantities of unused wood

in Rocky Mountain forests. Authors are David P. Lowery, Forestry Sciences Laboratory, Missoula; William A. Hillstrom, Houghton, Michigan; and Erwin E. Elert, Madison, Wisconsin.

The researchers compared characteristics of chips from sections of dead trees to chips from sections of green trees. Five-foot-long samples, taken from Engelmann spruce, Douglas-fir, western larch, and lodgepole pine in western Montana, were processed at the Forest Engineering Laboratory, Houghton.

Results showed overall chip quality was good, with few differences in size within species and between conditions. The dead trees produced slightly more unusable wood chips.

If you'd like to know more about this study, write to the Intermountain Station for a copy of "Chipping and Pulping Dead Trees of Four Rocky Mountain Timber Species," INT-RP-193-FR13.

50-year bibliography issued

Publications covering the Pacific Southwest Station's first 50 years of forestry and rangeland research are listed in a new reference book — "Fifty Years of Forestry Research: Annotated Bibliography of the Pacific Southwest Forest and Range Experiment Station, 1926-1975."

This 250-page paperback was compiled by Vincent Aitro, reference librarian at the Station's Berkeley, California, headquarters. The bibliography lists 2905 journal articles, research papers, and other scientific reports on such topics as silviculture, forest genetics, forest insects and diseases, insecticide evaluation, fire management, and management of watershed, range, wildlife, and recreation resources. Subject and author indexes are included. In addition, the bibliography contains a brief history of the Station, tracing its growth from a small group of scientists working in four offices at the University of California, Berkeley, to its present status as a modern research organization with a staff of more than 100 researchers and nine major facilities in California and Hawaii.

Although primarily concerned with the resource problems in California, Hawaii, and the Pacific Basin, the bibliography also lists reports that have regional and national application.

For copies, write the Pacific Southwest Station.

Guidelines to prevent beetle damage

Measures can be taken to cut losses of lodgepole pine to the mountain pine beetle in many forested areas in the Rocky Mountains, according to a report published by the Intermountain Station.

Authors of the report are Gene D. Amman, Intermountain Station, Ogden; Mark D. McGregor, Northern Region, Missoula; Donn B. Cahill, Rocky Mountain Region, Denver; and William H. Klein of the Forest Service's Methods Application Group, Davis, California.

The report discusses habits of the beetle and its strong preference for large lodgepole pine trees. Some alternatives that land managers can use to reduce losses by beetles are offered. Where timber production is the primary use of the land and stands contain only a few

large trees, they can be removed by partial cutting techniques to thwart beetle development. In other timber producing areas containing many large trees, the authors recommend removal of all trees in a stand.

The scientists observe that action against the beetle may not be required in areas committed to recreation. Trees of high value in campgrounds or picnic areas can, however, be protected from infestation by chemical sprays.

Copies of "Guidelines for Reducing Losses of Lodgepole Pine to the Mountain Pine Beetle in Unmanaged Stands in the Rocky Mountains," INT-GTR-36-FR13, are available from the Intermountain Station.

Listen to this

Suburban noise, from increasing vehicle traffic, is a growing concern for highway engineers, city planners, property owners, and land managers. A joint study between the University of Nebraska and the Rocky Mountain Station concludes that combinations of trees, shrubs, and solid barriers are effective in shielding suburban residential areas from intrusive noise.

The studies found that in most instances plantings and barriers complement each other in reducing noise levels. The combination of the two tends to provide more uniform control over a larger area than does either one separately. The relative position of the barriers of plantings between the noise source and the protected area is of major importance. The study also showed that noise from different sources requires different screening designs.

Details of this study are described in "Suburban Noise Control with Plant Materials and Solid Barriers" by David I. Cook, Department of Engineering Mechanics at the University of Nebraska, and David F. Van Haverbeke, Rocky Mountain Station. The publication is available for $1.00, plus $0.75 for mailing, from John Lagerstrom, Engineering Extension Department, W181 Nebraska Hall, University of Nebraska, Lincoln, Nebraska 68503.

Ponderosa pine regeneration

A new publication titled "Evaluation of Ponderosa Pine Reforestation Techniques in Central Arizona" lists results from studies of ponderosa pine regeneration over the past 15 years on several sites in central Arizona.

Management implications from this research state that: ponderosa pine should not be direct seeded on clay soils — results indicate the chances for success are slim. Successful direct seeding is more likely on coarser soils of limestone or sandstone origin.

Survival of natural regeneration is best on stony, gravelly, or sandy sites, and the same is true for planted trees. Planting offers a much greater chance of success than direct seeding, and is recommended for clay soils.

Finally, scientists L. J. Heidman, Frederic R. Larson, and W. J. Rietveld state that containerized plantings in the Southwest generally have been unsuccessful. Much of the failure is due to poor planting stock and a lack of site preparation.

If you would like to read more about these studies, obtain a copy of this report by writing the Rocky Mountain Station. Request research paper RM-190-FR13.

Rating habitat for the Abert squirrel

The Abert squirrel is unique in that its life necessities are furnished almost entirely by a single plant species — ponderosa pine. Squirrel welfare depends on managers being able to design timber harvests in a way that will maintain adequate habitat.

Several years ago, the Rocky Mountain Station began studies to determine the food and cover requirements of the Abert squirrel, and from these requirements to create a technique to assess the quality of habitat and how it is changed by forest succession and management practices.

As a result of this research, a rating system for squirrel habitat has been developed. The system assigns point values to individual habitat factors important to the squirrel's welfare — food, cover, and timber stand diversity. Field surveys of various types can be made to determine existing values. Totaled, these values yield an overall assessment of habitat conditions.

Land managers can use the rating system to determine when, where, how much, and what size of timber to harvest, while maintaining or improving habitat for the Abert squirrel.

If you would like additional details of this report, write the Rocky Mountain Station and request "Managing Southwestern Ponderosa Pine for the Abert Squirrel," a reprint from the *Journal of Forestry*, Vol. 75, No. 5, by David R. Patton.

Although these reports discuss research involving pesticides, such research does not imply that the pesticide has been registered or recommended for the use studied. Registration is necessary before any pesticide can be recommended. If not handled or applied properly, pesticides can be injurious to humans, domestic animals, desirable plants, fish, and wildlife. Always read and follow the directions on the pesticide container.

Keep a close watch for the April issue. It will cover such topics as: The National Fire Danger Rating System; Managing Forestlands in the Face of Catastropic Events; A Nationwide Fuel-Appraisal System; and much more.

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